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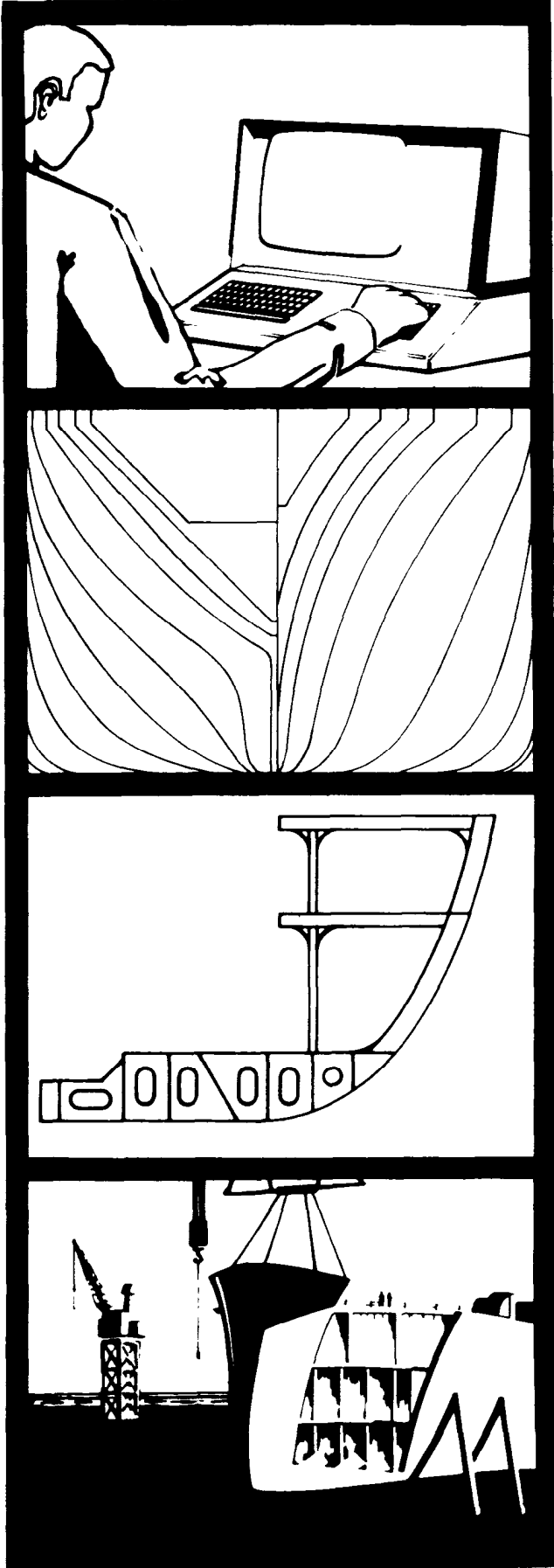
Proceedings of the REAPS Technical Symposium

Paper No. 6:
The IPD System for Interactive Part Coding and Nesting

U.S. DEPARTMENT OF THE NAVY
CARDEROCK DIVISION,
NAVAL SURFACE WARFARE CENTER

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R ESEARCH
E NGINEERING
 FOR
A UTOMATION
 AND
P RODUCTIVITY
 IN
S HIPBUILDING

AND

Proceedings of the

REAPS Technical Symposium

October 14-16, 1980

Philadelphia, Pennsylvania

THE IPD SYSTEM FOR INTERACTIVE PART CODING AND NESTING

Richard C. Moore
Manager, Computer Design Department
Newport News Shipbuilding and Dry Dock Company
Newport News, Virginia

Mr. Moore is responsible for development and implementation of computer aided design techniques. Primary areas of interest are structural and piping design where computer aided manufacturing systems are already in operation. He is also IPD project manager.

Mr. Moore holds degrees in naval architecture and marine engineering from the University of Michigan. He has 15 years of experience in structural production work including management responsibility in mold loft, fabrication, and assembly areas. Also implementation of computer systems for numerical control lofting/cutting, structural work packages.
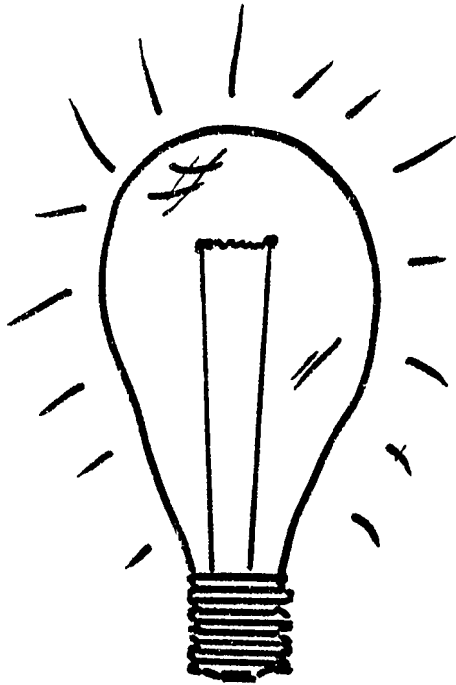
1975 IDEA

INTERACTIVE PARTS DEFINITION

MOLD LOFT
CURRENT TECHINQUES

DIGITIZING

ALKON
AUTOKON
NEST

PLOTTER

NC TAPE

SHOP
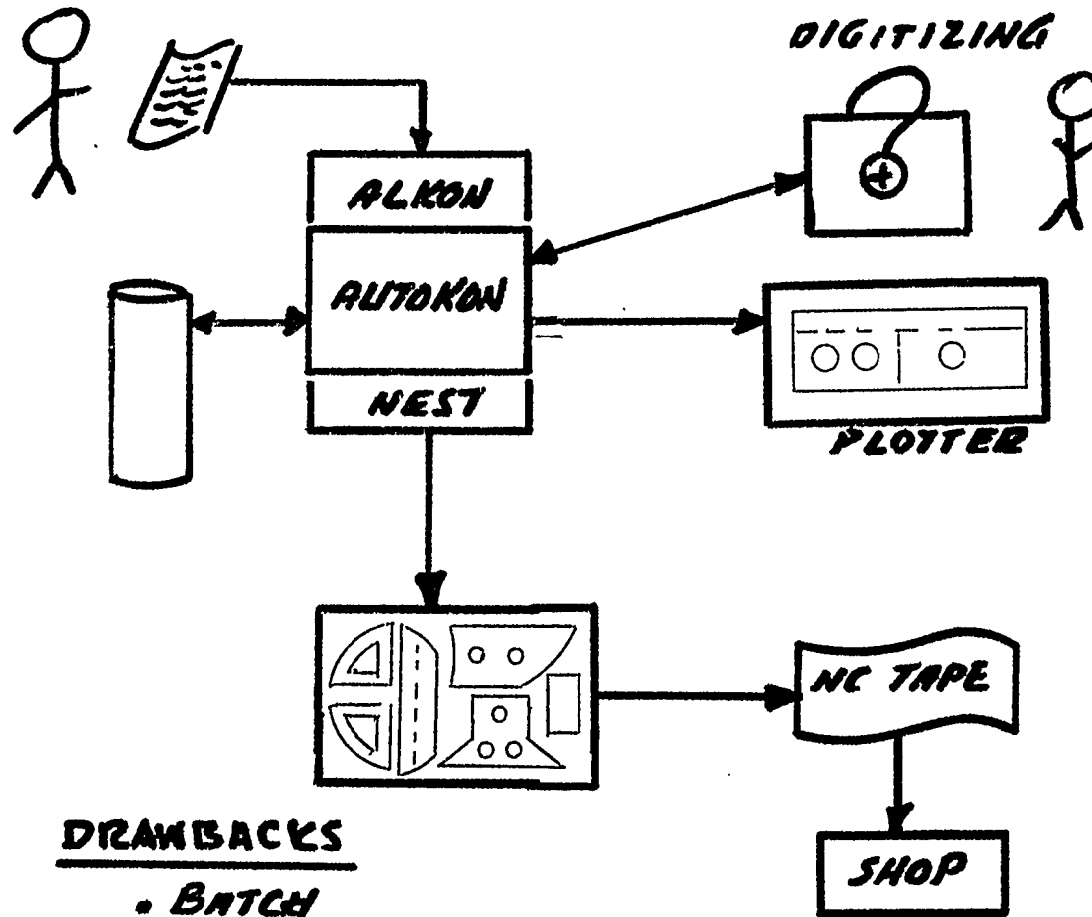
DRAWBACKS
- BATCH
- CORRECTION CYCLE
- TRAINING
- HUMAN ENGINEERING

MODIFY
SUBMIT
PLOT
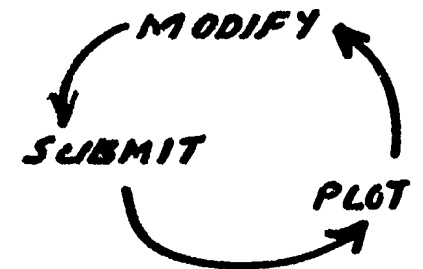
MOLD LOFT
PROPOSAL

PART GENERATION

AD 2000

AUTOKON

PLOTTER
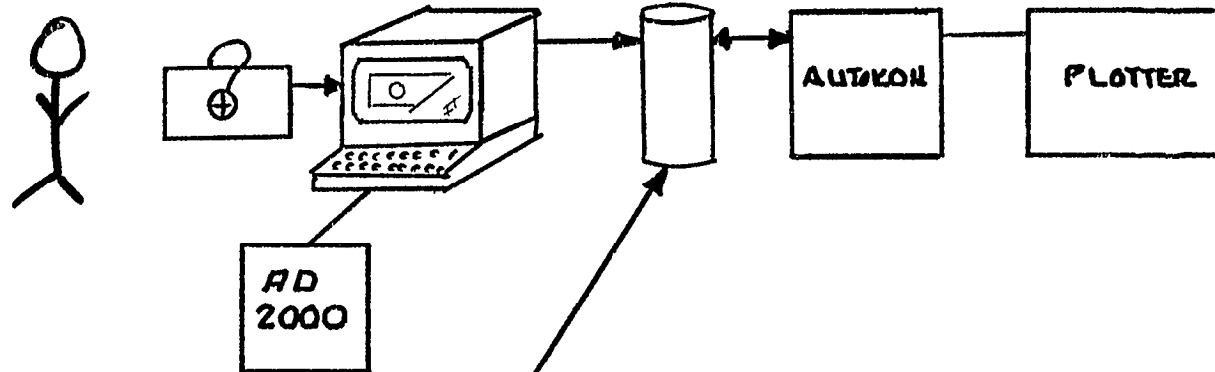
NESTING
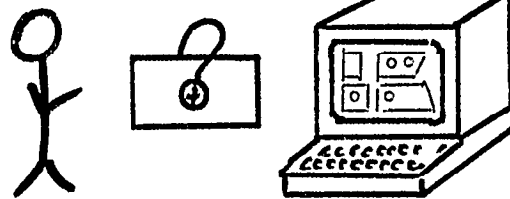
BENEFITS

- NO ERROR CYCLE
- ON-LINE RESPONSE
- HUMAN ENGINEERING

INTERACTIVE GRAPHICS PART DEFINITION

PROJECT

MAIN REQUIREMENTS OF IPD AS DEFINED BY NNS AND REAPS
TECH REPS,

- HARDWARE/SOFTWARE PACKAGE TO. ALLOW. USERS
  TO PERFORM REAL TIME DEFINITION OF THEIR
  APPLICATION WITH VISUAL (GRAPHIC) OUTPUT
  AND BUILD UP A DIGITAL MODEL. OF THE
  DEFINITION AT THE SAME TIME,

- MUST BE PORTABLE AND CAPABLE OF BEING UPDATED
  AND EXPANDED INDEPENDENTLY OF THE VENDOR,

- PROVIDE A GENERAL TOOL TO BE AVAILABLE FOR
  FUTURE GRAPHICS PROJECTS WITHIN U,S,
  SHIPBUILDING, -

- DEDICATED COMPUTER, HARDWARE TO PROVIDE
  RESPONSE. TO SUPPORT INTERACTIVE GRAPHICS,

- CAPABL OF DIRECT INTERFACE TO AUTOKON/
  SPADES/STEERBEAR SYSTEMS,

FUNCTIONAL AREAS ADDRESSED
BY IPD

- STRUCTURAL PART DEFINITION (CURRENT Lofting)

- NESTING

- STRUCTURAL SHOP DRAWINGS

- Nc MACHINING (APT)

- DESIGN USE

SECONDARY-EVENTS
AT NNS

167

MARAD

$

NNS

DELIVERABLES

CONTROL

BATH

R

SUN

BETHLEHEM

E

PETERSON

NASSCO

A

P

GENERAL DYNAMICS

McDERMOTT

BENEFITS TO NNS
- FIRST TO IMPLEMENT
- DEVELOPMENT FUNDS
- EXPERTISE GAINED

168
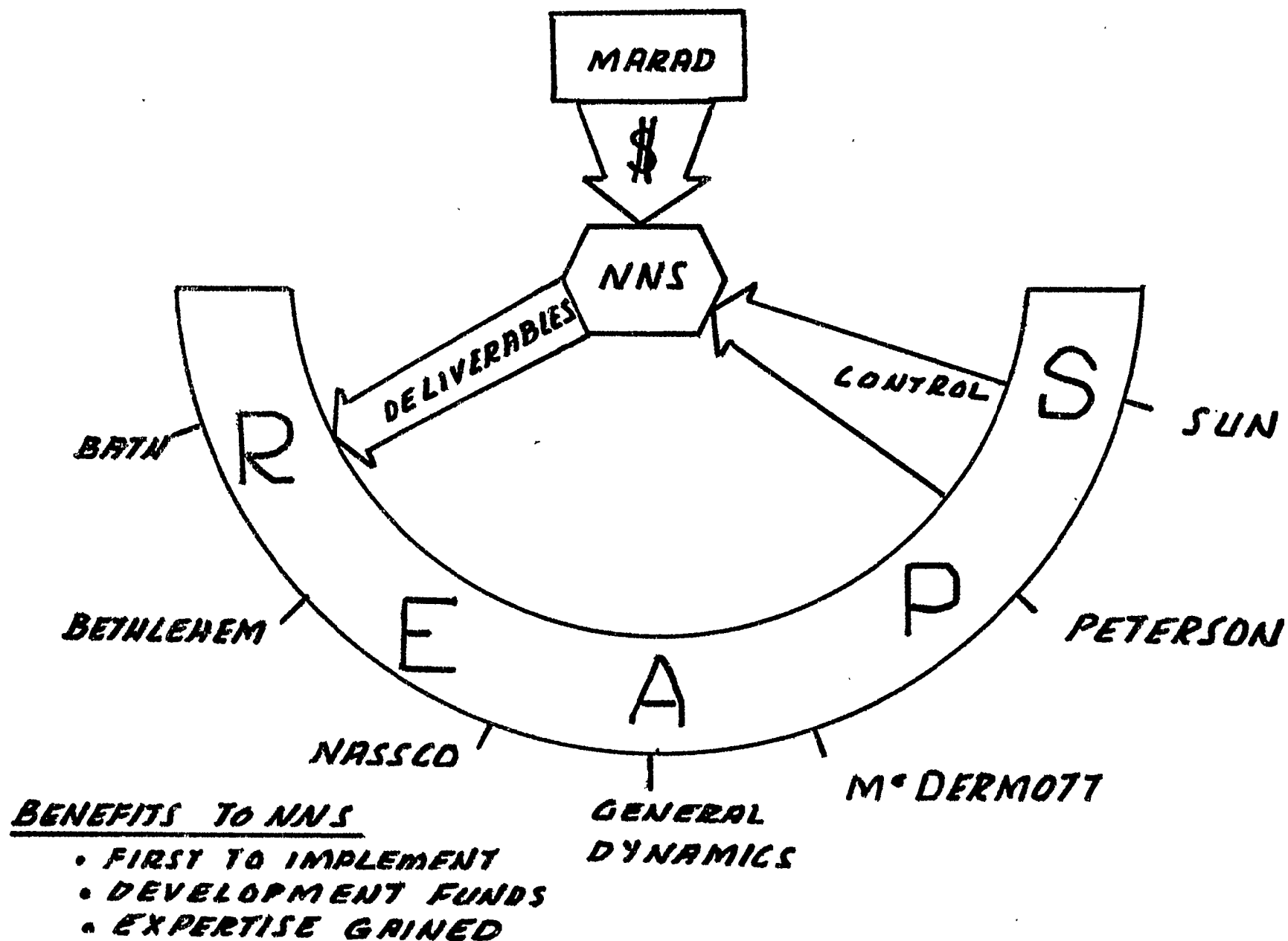
HARDWARE CONFIGURATION

9 TRACK TAPE

MAIN FRAME COMPUTER ON WHICH PRIMARY NC SYSTEM RESIDES (HIS 6000)

CONSOLE

32 BIT OR LARGER COMPUTER (PRIME 750)

PRINTER

HARD COPY PLOTTER

300 MEGA BYTE DISK

2ND DISK

CRT SCOPE   TABLET   KEY-BOARD

CRT SCOPE   TABLET   KEY-BOARD

OR

ALTEK 42 X 60 DIGITIZER OR EQUIVALENT
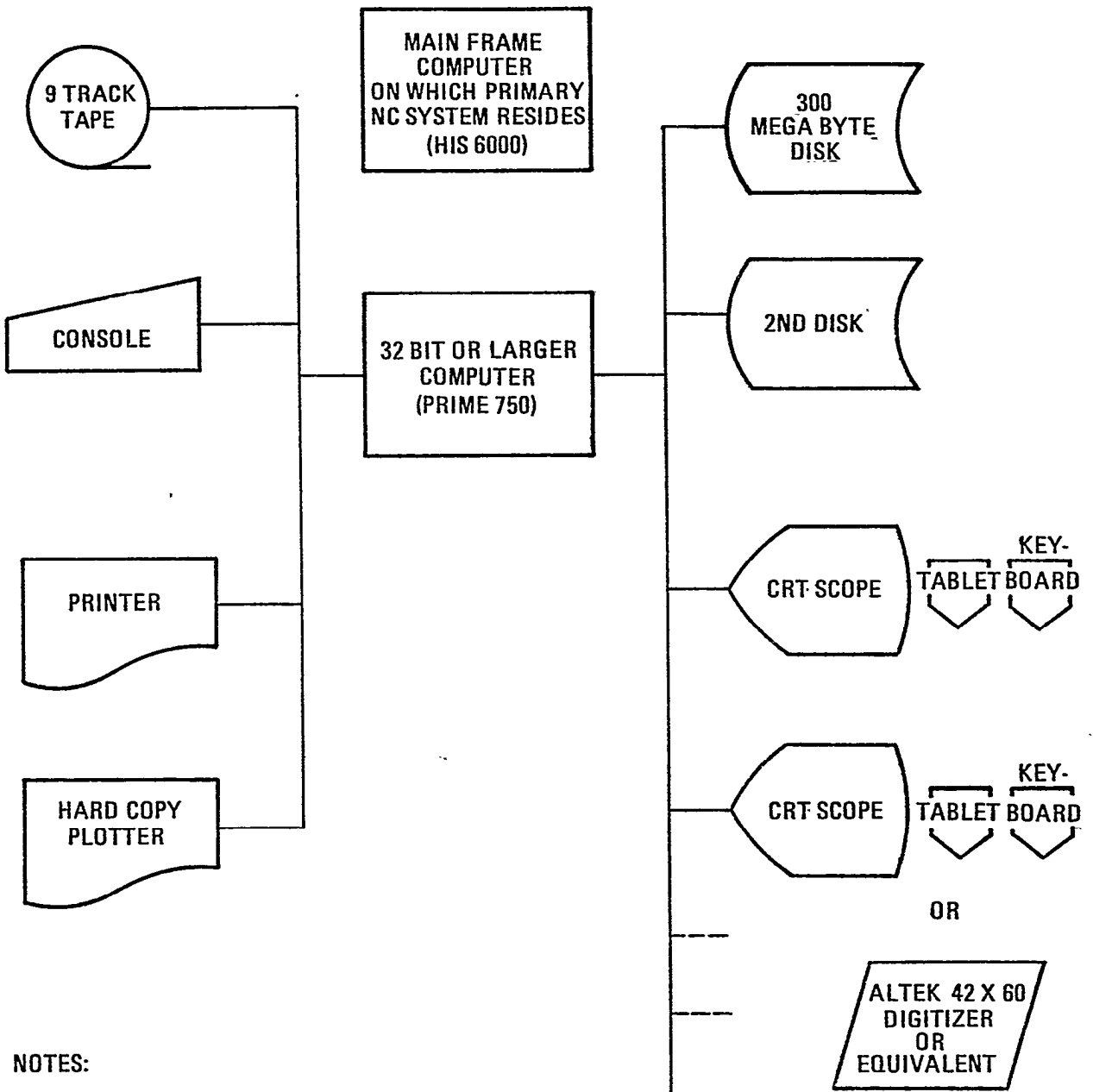
NOTES:

CRT WILL BE SEMI-REFRESH TO ACCOMPLISH NESTING AT A PRODUCTIVE RATE.

POSSIBLE PAPER TAPE READER/PUNCH REQUIREMENT.

IPD HARDWARE MODULES

PRIME 750

80 MB

300 MB

300 LPM

VERSATEC
24" ELECTROSTATIC

TEKTRONIX 4081

- LOCAL INTELLIGENCE
- SEMI REFRESH
- TABLET

REJECT	YES	OPERATION COMPLETE		NO	REPAINT	DEPTH	CANON					

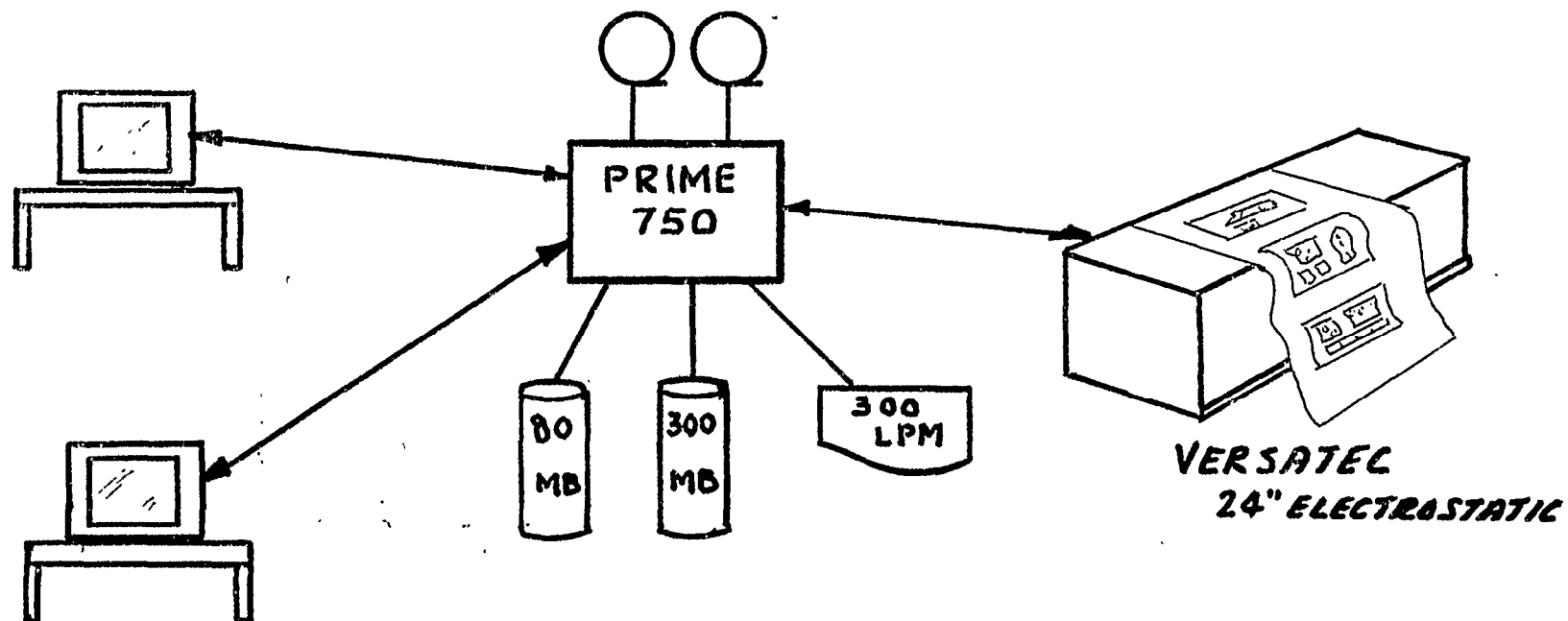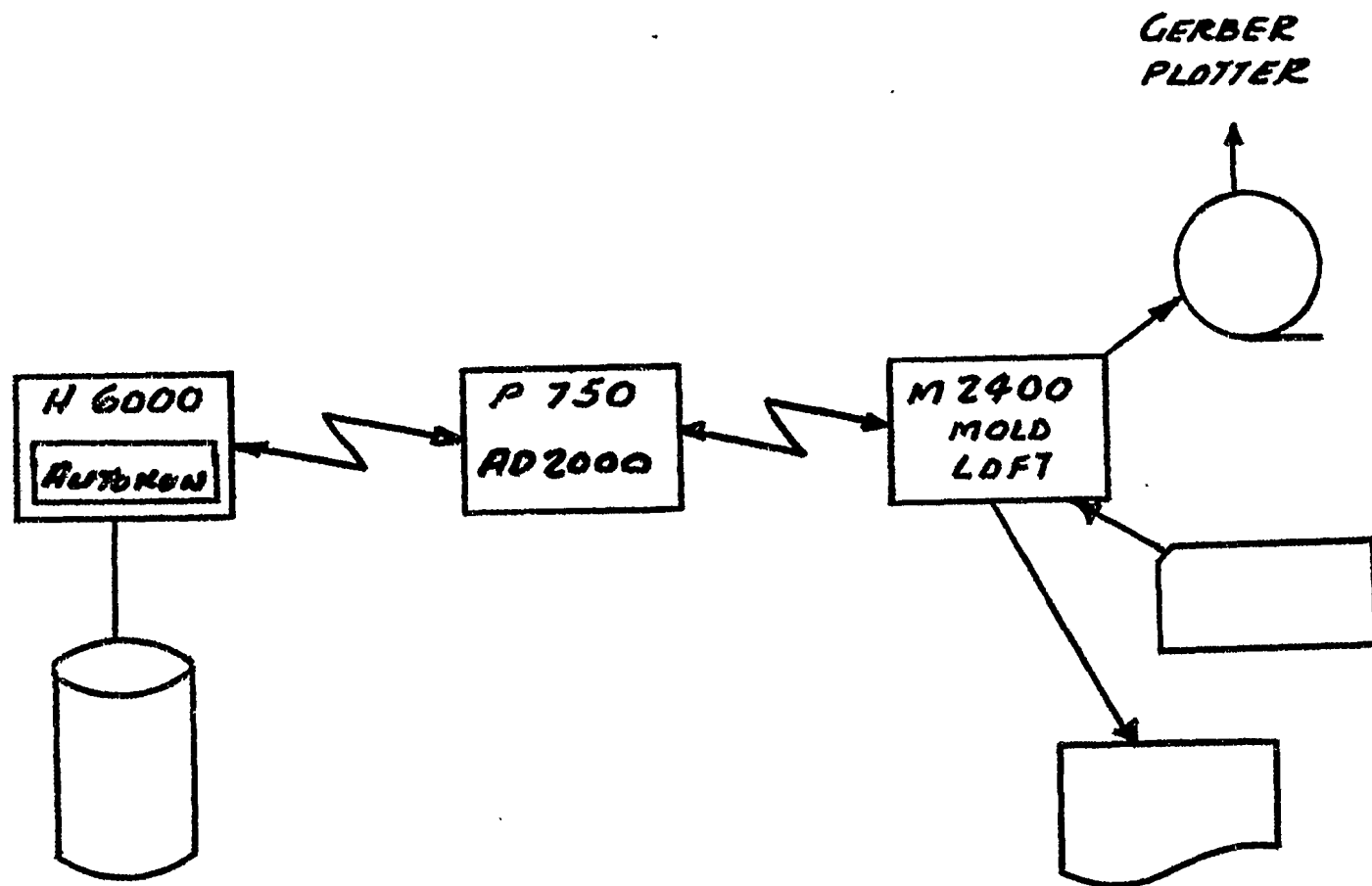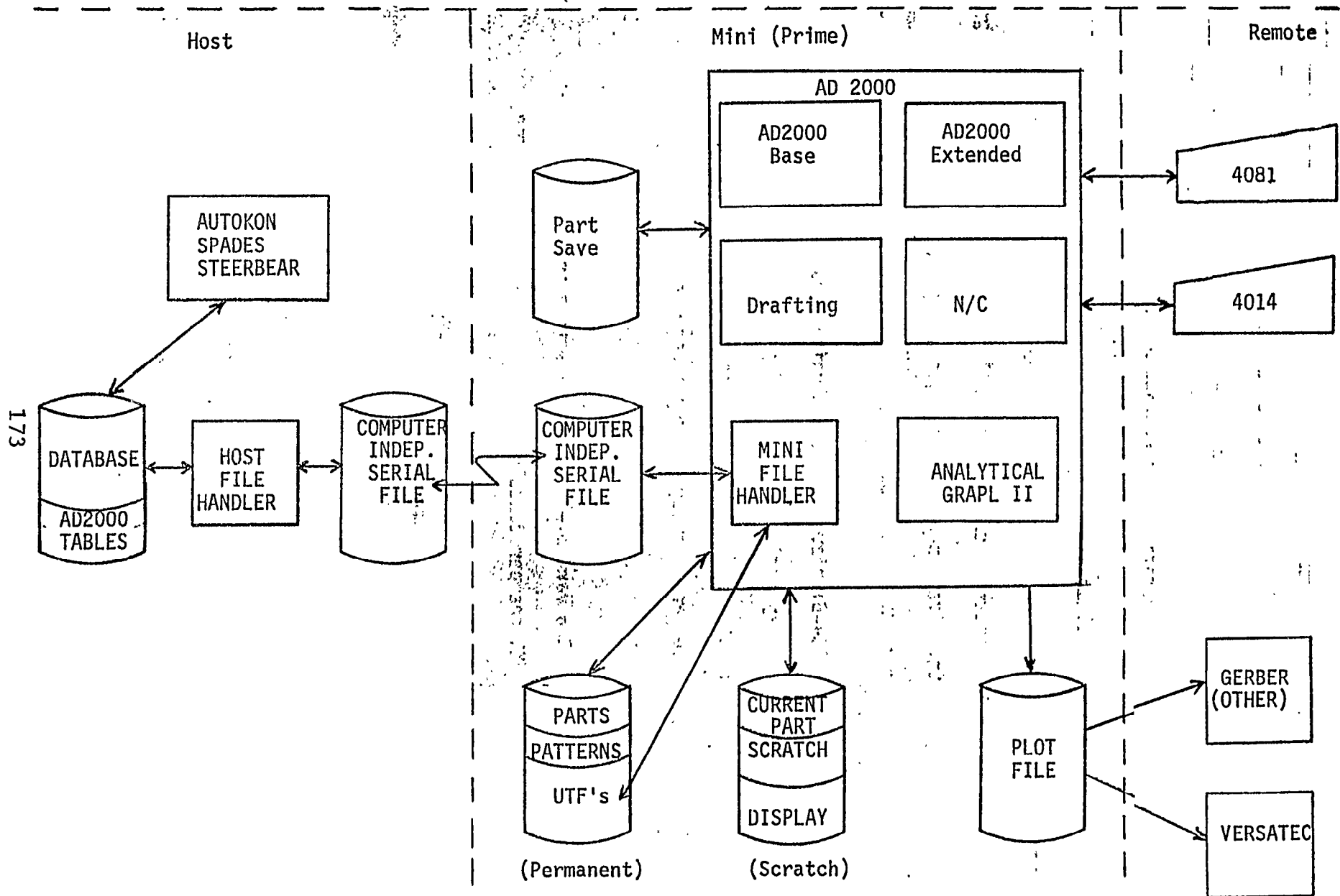| A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
U	V	W	X	Y	Z					0	1	2	3	4	5	6	7
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
.	+	,	−	=	!	∇∇	#	$	%	:	;	*	(	)	∇	&	

RETURN TO ORIGINAL SCALE	SELECT A NEW CENTER	NEW CENTER KEY-IN SCALE	DOUBLE SCALE	HALF SCALE	ALL POINTS	FROM TYPES	FROM ALL	LAST ENTITY CREATED

Z O O M — *D E L E T E*

KEY-IN SCALE	DIAGONAL POINTS	KEY-IN MAX-MINS	AUTO MAX-MINS	SAVE ZOOM STATUS	ALL NOT DISPLAYED	ALL OF A DISPLAYED TYPE	ALL OF A TYPE NOT DISPLAYED	ALL OF A LEVEL

ENTITY TYPES → POINT	LINE	ARC/CIRCLE	CONIC	SPLINE	OTHER CURVES	GROUP AND ARRAY	EXT. GEOM. CURVE	SURFACE	LABEL AND NOTE	DIMEN.	CENTER LINE	CROSS HATCH

DISPLAY TOLERANCE	SYSTEM DECIMAL PLACES	CHANGE CURVE FONT	MODIFY ENTITY LEVEL, FONT, OR PEN NO.	CONTROL SURFACE PATHS	CHANGE CURSOR MODE	CONTROL VIEW VECTORS	SEQ. NO./ POINTER SELECT	DISPLAY TITLE BLOCK

B L A N K — *U N B L A*

ALL OF A TYPE	ALL EXCEPT A TYPE	ALL	SELECT FROM TYPE	SELECT FROM ALL	LEVELS	ALL	ALL OF A TYPE	ALL EXCEPT A TYPE

SCREEN POSITION	KEY-IN	POLAR	DELTA	CIRCLE CENTER	ON A CIRCLE AT AN ANGLE	SCREEN POSITION	KEY-IN	JOIN 2 POINT

| XT:
YT:
ZT: | | R ANGLE | DY DX | | | | X1:
Y1:
Z1:
X2:
Y2:
Z2: | |

CURVE ENDPOINT	INTERSECTION OF TWO CURVES	VECTORED	REGENERATE SPLINE POINTS	ON A LINE AT A COORDINATE	CURVE NORMAL	THRU POINT HORIZ/VERT	THRU POINT TANTO CURVE	PARLEL TO LINE AT A DISTANCE

INTERFACES

GERBER PLOTTER

H 6000
AUTOKON

P 750
AD 2000

M 2400
MOLD
LOFT

IPD Software Modules

Host | Mini (Prime) | Remote

Host:
- AUTOKON SPADES STEERBEAR
- DATABASE / AD2000 TABLES
- HOST FILE HANDLER
- COMPUTER INDEP. SERIAL FILE

Mini (Prime):
- COMPUTER INDEP. SERIAL FILE
- Part Save

AD 2000:
- AD2000 Base
- AD2000 Extended
- Drafting
- N/C
- MINI FILE HANDLER
- ANALYTICAL GRAPL II

- PARTS / PATTERNS / UTF's (Permanent)
- CURRENT PART SCRATCH / DISPLAY (Scratch)
- PLOT FILE

Remote:
- 4081
- 4014
- GERBER (OTHER)
- VERSATEC

173

"PRIME" TRNG.

INSTALL AD 2000
ON PRIME

M50 USING
AD 2000

PLOTTER
INTERFACES

TABLES
AVAILABLE

DOCUMENTATION

SHOP
DWG

980

1981

1982

174

"PRIME"
COMPUTER
INTERFACE

AUTOKON
AD 2000
INTERFACE

NORMS
AVAILABLE

NEST
AVAILABLE

PARTS
DEFINITION

WORKSHOP

PROJECT PLAN
PHASE II

	MONTH OF COMPLETION FROM START OF PHASE
* • ISSUE PURCHASE ORDERS	1
* • PRIME TRAINING	3
* • DEFINE DATA SPECIFICATION	5
* • AD 2000 INTERFACE	5
* • WRITE HOST ROUTINES	7
* • HARDWARE/SOFTWARE INSTALLATION	7
* • RJE INTERFACE	7
* • AD 2000 INSTALLATION	9
• AD 2000 TRAINING	10
* • MINI SEND/RECEIVE	12
• REFINE NEST	20
• REFINE NORMS	15
• TABLES	19
• SHOP DRAWING CAPABILITY	20
• REFINE PARTS DEFINITION	20
• DOCUMENTATION	23
• WORKSHOP	24

*INDICATES WORK ALREADY COMPLETE
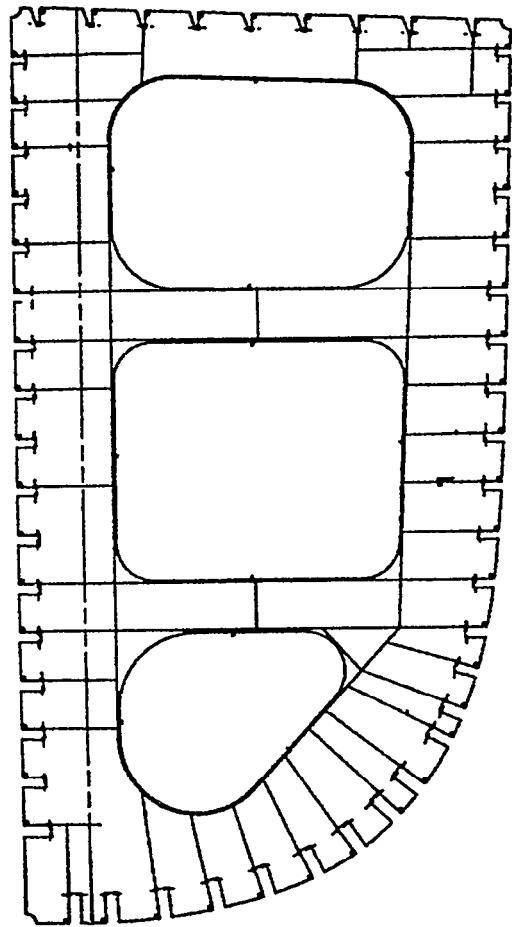
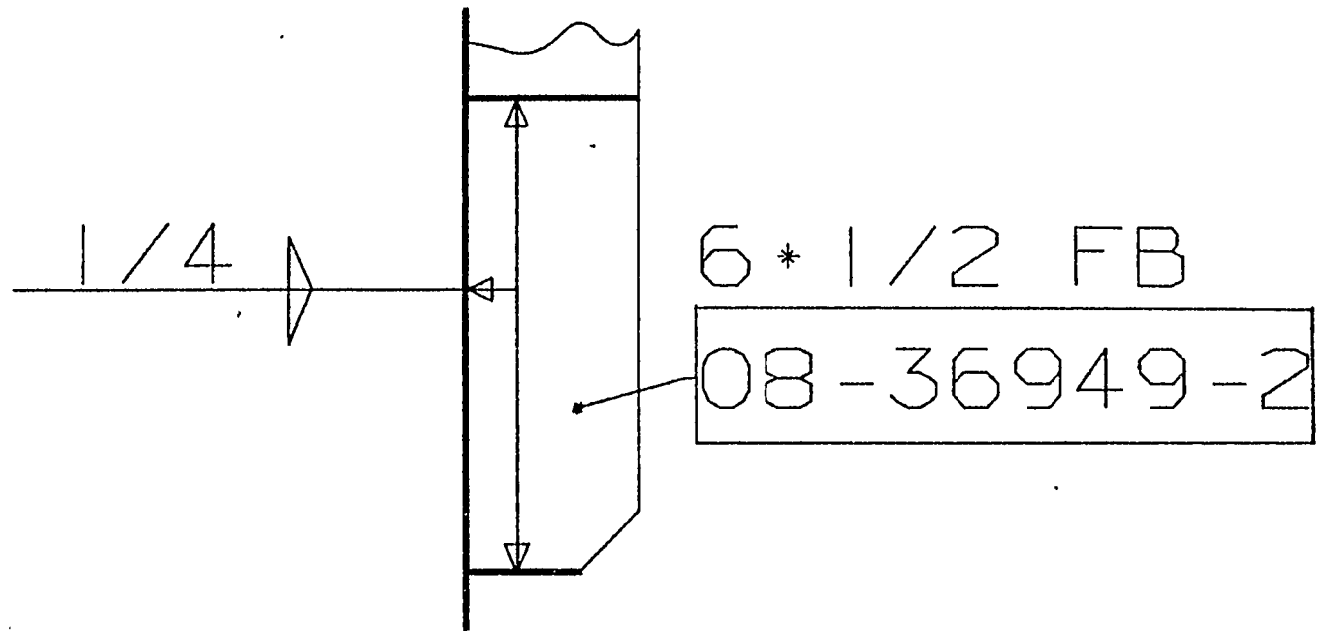BLANK/UNBLANK

MODIFY LEVEL/PEN NO.

BLANK/UNBLANK
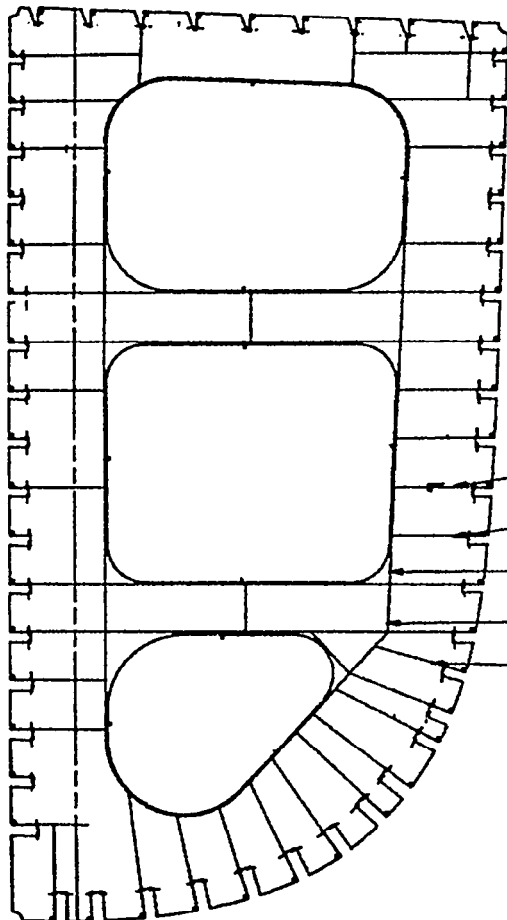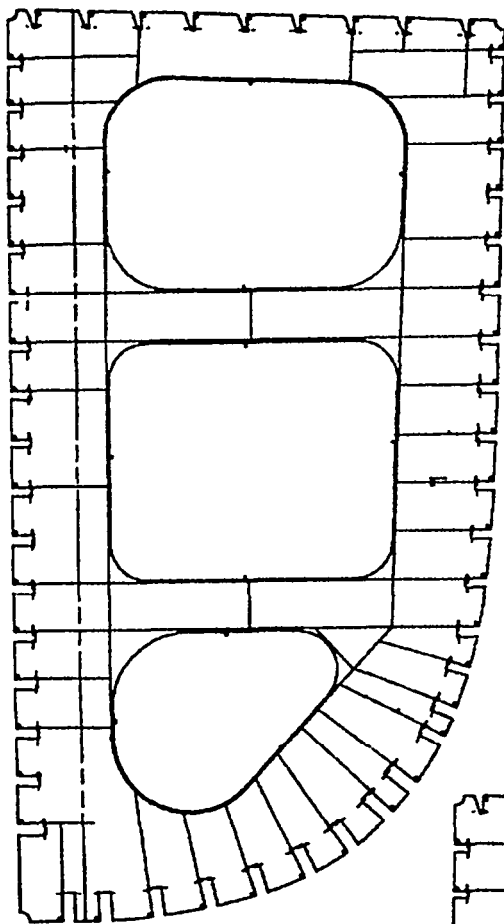

17.85 * FLG P:5 FLG
08-12061-2 DETAIL 2-B

5 * 7/16 FB
08-35161-2 DETAIL 2-A

8 * 3/4 FB
08-16612-2
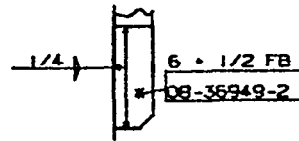
8 * 3/4 FB
08-35187-2

5 * 7/16 FB
08-35160-2 DETAIL 2-A

177

1/4

6 * 1/2 FB

08-36949-2

DETAIL 2-A1

AD-2000

6 · 1/2 FB
08-36949-2

1/4
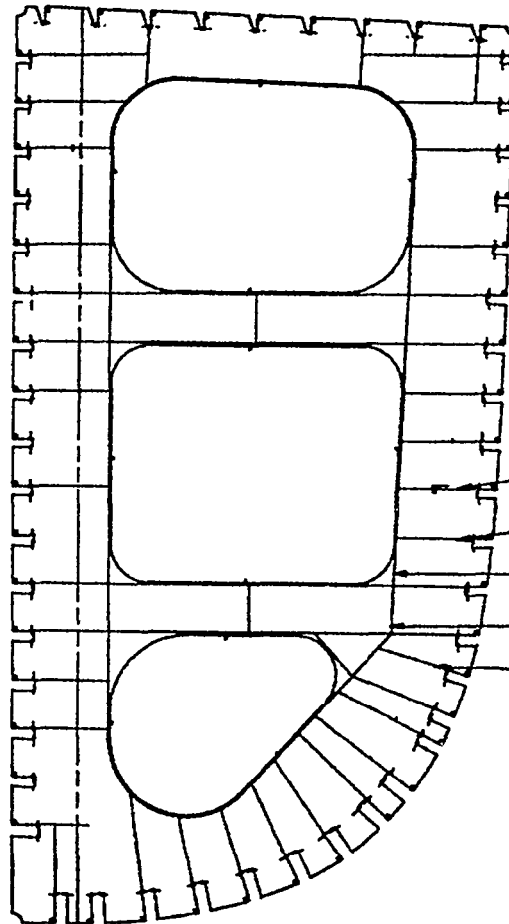
DETAIL 2-A1

AD-2000

17.85 · FLG P:5 FLG
08-12061-2 DETAIL 2-B

5 · 7/16 FB
08-35161-2 DETAIL 2-A

8 · 3/4 FB
08-16612-2

8 · 3/4 FB
08-35187-2

5 · 7/16 FB
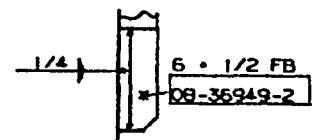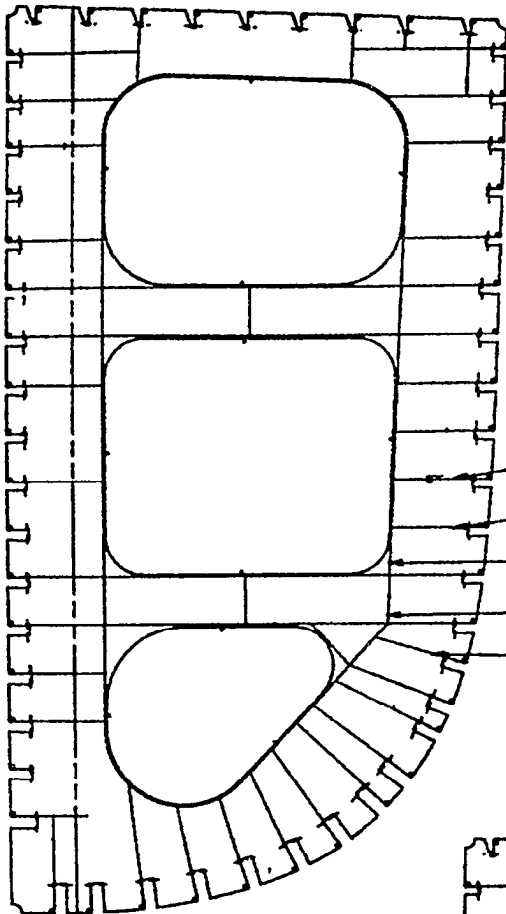08-35160-2 DETAIL 2-A

6 · 1/2 FB
08-36949-2

1/4

DETAIL 2-A1

179

AD-2000

17.85 ∅ FLG P:5 FLG
08-12061-2 DETAIL 2-B

5 · 7/16 FB
08-35161-2 DETAIL 2-A

8 · 3/4 FB
08-16612-2

8 · 3/4 FB
08-35187-2

5 · 7/16 FB
08-35160-2 DETAIL 2-A

1/4

6 · 1/2 FB
08-36949-2

DETAIL 2-A1

AD-2000

1/4
TYP

8-1/2 · 30.6∅P
08-16618-2
DET 4-B1

1/4

6 · 1/2 FB
08-36949-2

DETAIL 2-A1

17.85 ∅ FLG P:5 FLG
08-12061-2 DETAIL 2-B

5 · 7/16 FB
08-35161-2 DETAIL 2-A

8 · 3/4 FB
08-16612-2

8 · 3/4 FB
08-35187-2

5 · 7/16 FB
08-35160-2 DETAIL 2-A

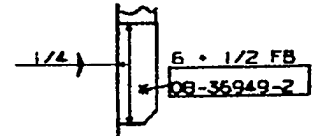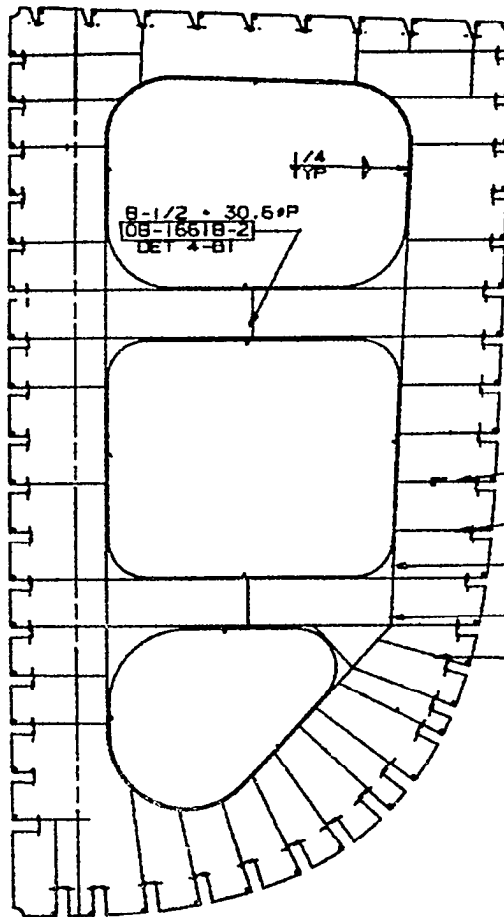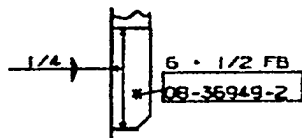180

GROOVE-LOCATE AS SHOWN
⅛ RAD. APPROX - APPROX ¹/₃₂ DEEP

ALL OVER
EXCEPT AS
SHOWN.

2 GROOVES - 180° APART
⅛ RAD. - APPROX ¹/₁₂ DEEP

DRILL HOLE ⅞ DEEP,
TAP ½ DIA-13UNC2B
FOR ⑫

⅑₆ X 45° CHAM.

30 ONLY:
KEYWAY ⅛ WIDE X
⅛ DEEP FOR
㉜

¹/₆₄ RAD

PC-30 ONLY:
SPOT WITH DRILL AT
ASSY WITH PC-31
FOR PC-32.

¹/₁₂ X 45 CHAM.

SEE DETAIL
"4-A"

.010" RAD.
(MAX)

.248" DIA
1.236"

.125

4 ²³/₃₂"

2 ⅛"

15/16"

1¾ RAD

1.248" DIA
1.246"

1.383" DIA
1.381"

1.623" DIA
1.621"

BREAK CORNERS
.005 RAD APPROX

PC-30 ONLY:
KEY & FLATS C's TO BE
HELD ANGULARY WITHIN
0° 30' OF EACH OTHER

.865"
.867"

BREAK SHARP
EDGES

.5125" ±.002" DIA BALL TO BE
SPHERICAL WITHIN .002".

1¾ RAD

.125

ALL DIA TO BE
CONCENTRIC
WITHIN .002" T.I.R.

SCALE: 12":1'-0"

TO BE CENTERED
WITHIN .002"

½ RAD

DETAIL "4-A"
SCALE: 24":1'-0"

5 ³¹/₃₂"
FOR
⑤

181
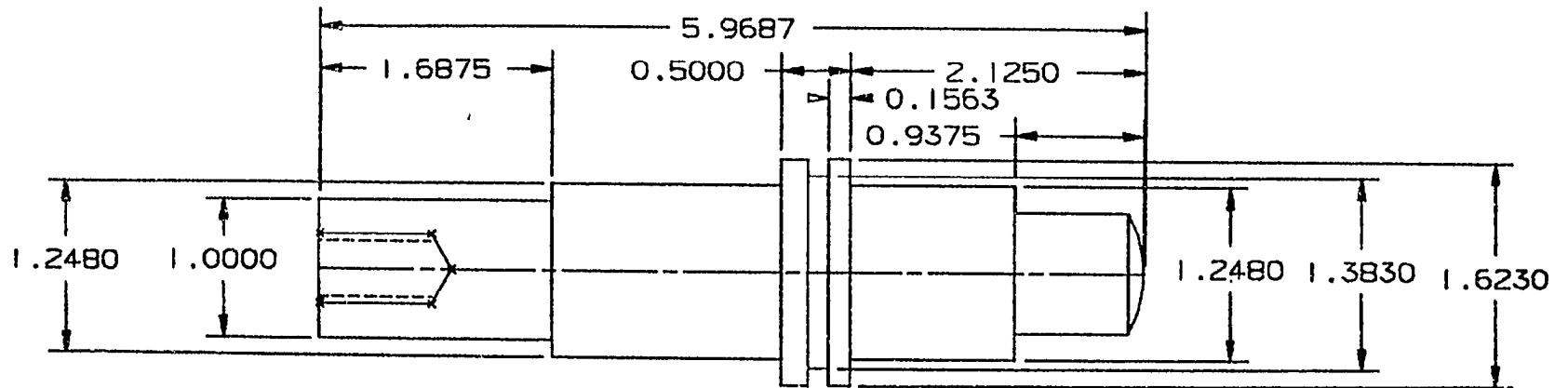
LEVEL MANAGEMENT

LISTING FOR 'STEM
0. DRAWING SPACE
1. TURNING GEOMETRY
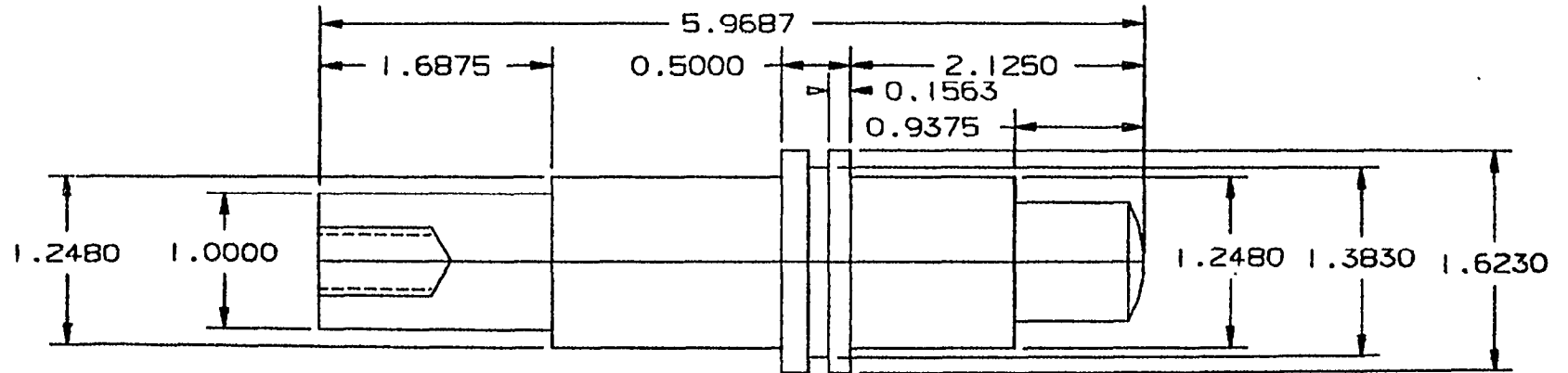2. MILLING GEOMETRY
3. DIMENSIONS
4. NOTES
5. GEOMETRY POINTS

HIT YES OR NO TO CONTINUE Y
LEVEL MANAGEMENT

5.9687

1.6875   0.5000   2.1250
0.1563
0.9375

1.2480   1.0000   1.2480 1.3830 1.6230

m-2884

183

5.9687

1.6875 · · 0.5000 · 2.1250

0.1563

0.9375

1.2480 · 1.0000

1.2480 · 1.3830 · 1.6230

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